



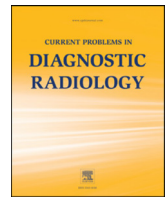
Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.



Current Problems in Diagnostic Radiology

journal homepage: www.cpdjournal.com



Virtual Journal Club Beyond the Pandemic: An Enduring and Fluid Educational Forum



Lily M. Belfi, MD^{a,*}, Kathryn E. Dean, MD^a, David S. Sailer, MD^b, Thomas Kesler, MD^c, Sheryl G. Jordan, MD^b

^a Department of Radiology, Weill Cornell Medicine, New York, NY

^b Department of Radiology, University of North Carolina School of Medicine, New York, NY

^c Roper Radiologists, Charleston, SC

ABSTRACT

Objective: Since its inception, journal club has been a cornerstone to the life-long process of medical education. The virtual journal club (VJC), initiated as a robust solution to many educational challenges encountered during COVID-19 pandemic-related distance learning, provides an enduring and fluid forum for multilevel teaching and learning.

Materials and Methods: In this manuscript we share our institutions' reasoning and methods to implement a VJC for multi-level learners. A standardized format applicable to all VJC sessions was adopted to ensure reproducibility from presenter to presenter. Sessions were held via video conference platforms. Pedagogy regularly emphasized in undergraduate medical education was adopted. Informal assessment of each session's strengths and areas for improvement was performed.

Results: A total of 30 sessions were held prior to manuscript submission, including discussion of 36 refereed journal articles from March 26, 2020, to April 20, 2021. The virtual journal club was very well received by all participants. The medical students and residents found the information current and engaging. The fellows stated that the journal club strengthened their knowledge base and enhanced communication and teaching skills. The attendings learned from its encouraged frank discussion of differing practice patterns. The format of these sessions offers an ideal setting to teach medical students and residents how to evaluate and employ evidence-based medicine and meets multiple LCME and ACGME requirements.

Conclusions: This VJC forum allows for development of essential nonclinical skills including lifelong active learning and analysis, peer collaboration, and technology adaptation and usage.

© 2021 Elsevier Inc. All rights reserved.

Background

The COVID-19 pandemic profoundly impacted the constructs of radiology medical education, centered on maintaining effective and dynamic training under the constraints of appropriate social distancing policies. These necessitated large-scale shifts in approaches to the radiology curricula and provided a chance to reexamine the entire pedagogy and capitalize on new opportunities in a new virtual online format. One opportunity to reformat is the journal club. Here we present our experience with establishing a radiology journal club integrated into radiology undergraduate and graduate curricula in a virtual and multi-institution format.

The origin of the journal club dates to 1875 at McGill University in Montreal. Sir William Osler found the collective reading of medical literature to be a solution for those who could not afford the expensive print journals and books. Today's journal clubs

teach evidence-based medicine with critical appraisal of the medical literature and encourage lifelong learning.^{1,2} Traditional formats would have that journal clubs be held in an in-person format where groups ranging in size can actively engage in the process being led by a single presenter or group of presenters. As with any facet of education, the foundations of the traditional journal club can be added to and improved upon to better address the real-time needs of students and educators.^{3–5} One such way journal clubs have evolved is the application of virtual journal club (VJC). Initially conceived to address the harried schedules and variable physical locations of clinicians and researchers, matched with increased availability of necessary technology, the success of VJCs pre-pandemic and intra-pandemic has been previously described.^{1,6–8}

In this manuscript we share our institutions' reasoning and methods to implement a VJC for multi-level learners. The format of these sessions offered an ideal setting to teach medical students and residents how to evaluate and employ evidence-based medicine. This virtual forum allowed for development of essential nonclinical skills including lifelong active learning and analysis, peer collaboration, and technology adaptation and usage. An existing resident-led journal club format was adapted.⁹

*Reprint requests: Lily M. Belfi, MD, Associate Professor of Clinical Radiology, Director of Medical Student Education, Division of Emergency/Musculoskeletal Radiology, Department of Radiology, Weill Cornell Medicine, 525 East 68th St, Room F-054, New York, NY 10065.

E-mail address: lib9050@med.cornell.edu (L.M. Belfi).

Methods

To rapidly adapt to pandemic barriers to traditional radiology education, VJC educational goals were established with emphasis on the trainee as co-educator. Specific goals for learners included a. select an article of interest, b. apply learned information to a current case or clinical practice, c. judge article validity and present the information using a virtual platform, d. participate in discussion with experts in the field, and e. increase communication skills.

The first virtual session occurred early in the pandemic schedule in March 2020. The majority of attendees had not yet begun participating in online learning and attention was directed to assuring participants had both adequate video and audio connection. The senior author's department's favored and IT-supported videoconference platform (Cisco Webex, Santa Clara, CA) was selected for ease. Participant locations varied; some attended from computer stations in separate rooms at work and others attended from home.

Initially, two recent major journal articles were presented by learners, specifically one on-rotation resident and a supervising fellow; multilevel learners participated in a traditional albeit virtual format comprised of article presentation (methods, results, limitations, discussion) and brief question and answer session, for each article. Collaborative learning and multilevel learning were strengths of this approach.

Significant refinements were made in subsequent journal clubs, to include pedagogy, attendees, article selection, and format.

Pedagogy regularly emphasized in undergraduate medical education was adopted, as suggested by one of the authors who participated in the journal club series as component of his medical school scholarly concentration program project in medical education. Adding learning objectives and spaced repetition, and reducing cognitive load were specifically targeted, illustrated in [Figure 1](#).¹⁰⁻¹³

Attendees at VJC's outset included all division faculty members, fellows, residents, and interested medical students. Because the pandemic spanned several months in 2020, the journal club participants varied, with learner levels spanning from medical students to senior faculty, including postgraduate year 2, 4, and 5 residents, and a single division's (breast imaging) fellows. Employing pedagogy proved advantageous irrespective of learner level. The VJC evolved from mid 2020 through early 2021 to center on medical students in radiology course blocks and electives, including a multi-institutional collaboration with students in radiology electives at the first author's institution.

Article selection from acclaimed journals represented topics of current interest or pertinent to a recent patient presentation or dilemma; examples included COVID-19, management of breast pain, virtual interview season, ultrasound features of mucinous ovarian tumors, imaging acute female pelvic pathology, comparison of fluorescence and x-ray cholangiography in laparoscopic cholecystectomy, and the role of doppler sonography in detecting portal vein stenosis after liver transplantation.¹⁴⁻¹⁷ The number of articles discussed at each journal club varied; most frequently, one article per journal club was selected by on service learners and vetted by the

faculty adviser; however, two medical student sessions expanded to discuss three articles each.

A standardized format applicable to all VJC sessions was adopted to ensure reproducibility from presenter to presenter. The format was the following: (1) Title page; (2) Outline; (3) Learning objectives; (4) Relevant case presentation to frame the clinical questions and seek the best available evidence; (5) Journal article introduction; (6) Material and methods; (7) Results; (8) Discussion and limitations; (9) Future direction; and (10) Q&A with learning objective recap and feedback. Slides were simplified with black, sans serif font on a white background to reduce learner cognitive load and offered spaced repetition ([Fig 1](#)) ([Appendix](#)).¹³

From March to June 2020, VJC sessions centered on a division's on-block multilevel learners during pandemic downtime. Thereafter, VJC sessions transitioned to medical student-centric and were offered during scheduled medical student electives in radiology.

Informal assessment of each session's strengths and areas for improvement was performed. To enhance the learner participation, an alternate videoconferencing platform was chosen. Zoom videoconferencing software (Zoom Video Communications, San Jose, CA) allowed for real time annotation and was found to be especially helpful during the case presentation.

Most aspects of journal club were optimized to dovetail with specific medical student competencies and standards and resident training requirements.¹⁷⁻²¹

Results

Outcomes

A total of 30 sessions were held prior to manuscript submission, including discussion of 36 refereed journal articles from March 26, 2020 to April 20, 2021.

We received positive feedback from participants regarding the standardized format. The consistent format provided familiarity making it easier for both presenters and attendees to follow each session. Iterative learning objectives were impactful. Direct solicitation of discussion by each participant was appreciated, as were synopsis teaching points. Case presentation at each journal club outset established relatability as an example of case-based learning and shaped more robust discussion and increased resident participation. At completion of presentation of the article, focused discussion questions were offered. These allowed for added learner participation and opportunity for attending physicians to participate in the discussion. Multidisciplinary physicians also attended the virtual journal club when apropos and participated in discussion yielding even more robust discussions and enhanced learning.

The Liaison Committee for Medical Education (LCME) and the Accreditation Council for Graduate Medical Education (ACGME) prescribe core competency categories each successful medical student and resident must be given ample opportunity to achieve in a supportive learning environment ([Table 1](#)). The VJC fulfilled many of these requirements for our multi-level learners.

VJC supplemented residency education in a variety of ways specifically addressing in force ACGME residency program requirements and Milestones reporting.^{17,19,22} Each VJC session afforded opportunity for radiology residents to advance performance metrics. The VJC model offered education in case-based patient care, medical knowledge, tenets of the basic principles of scientific inquiry, including research design and translation to evidence-based patient care.²³ The model offered an excellent opportunity to advance residents' communication skills and improve teaching skills.²⁴ Lifelong learning skills were cultivated in fellows, residents, and medical students alike, particularly by the novel approach of centering each journal club on a recent patient case in a manner that "sent learners to the literature" to provide evidence-based care. VJC offered insight into residents' professionalism, specifically professional behavior, accountability, and conscientiousness. Medical students were also afforded the opportunity to publish their presentation to

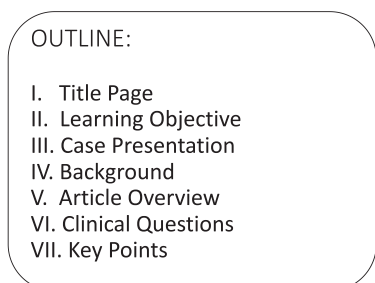


FIG 1. VJC Template Outline. The VJC Template used is available as a downloadable resource in [Appendix A](#).

TABLE 1
Core competency categories for medical students (LCME) and residents (ACGME)

LCME	ACGME	Virtual Journal Club fulfills via . . .
Patient care and clinical skills	Patient care	Application of clinical reasoning and critical thinking skills in developing a differential diagnosis and management plan
Medical knowledge	Medical knowledge	Demonstration of knowledge about established and evolving biomedical, clinical, and cognate sciences and the application of this knowledge in patient care
Interpersonal and communication skills	Interpersonal and communication skills	Effective communication in oral format with colleagues and other health care professionals
Professionalism	Professionalism	Meeting expectations for the medical profession including accountability, confidentiality, truthfulness, responsiveness to feedback, punctuality, and attire
Lifelong patient care learning	Practice-based learning and improvement	Investigation and evaluation of patient care practices, appraisal and assimilation of scientific evidence, and improvement of the practice of medicine
Social & health systems science	System-based practice	Demonstration of an awareness and responsiveness to the larger system of health care to improve the health of specific clinical populations

an institutional open access departmental website [<https://msrads.web.unc.edu/journal-club/>] and were advised to add this to their ERAS applications as well.

The virtual journal club was very well received by all participants. The medical students and residents found the information current and engaging. The fellows stated that the journal club strengthened their knowledge base and enhanced communication and teaching skills. The attendings learned from its encouraged frank discussion of differing practice patterns.

There were, however, barriers and limitations. Barriers to the online format came from early technical issues, most notably speakers losing internet connection. Remote learning posed the challenge of keeping all participants engaged and vocal, particularly when a power point presentation was being shared in full screen. And lastly, the novel model itself was unfamiliar to many participants, as it did not follow a typical journal club format.

Discussion

Since its inception, journal club has been a cornerstone to the lifelong process of medical education, serving as a means for physicians to learn about medical developments, critically evaluate the soundness of the research, assess clinical applicability, and promote discussion amongst colleagues.^{9,25,26} The key goal of journal club is to promote critical literature appraisal and an evidence-based practice of medicine.²⁷⁻²⁹ While a lifelong process, journal club can serve a formative role in the transition to clinical years for the medical student.³⁰ In the shift away from the traditional classroom, medical students are often faced with the challenge of adapting learning styles in a less structured and more hands-on educational format.³¹ To promote critical thinking, problem-based learning sessions exemplified by this journal club innovative format are foundational instruments to medical education, in the early clinical years and beyond.

Frameworks of learner core competencies are provided, and required, to meet accreditation standards for undergraduate and graduate medical education under LCME and ACGME oversight committees. The journal club experience serves to meet both LCME and ACGME frameworks well and can offer integral medical education. With the aid of video conferencing software, the pandemic-necessitated virtual transition has demonstrated many advantages including flexibility in scheduling (participants can log in from anywhere), ability to offer synchronous or asynchronous sessions (live vs pre-recorded presentations), ability to include those from other sites/institutions (experts in the field, journal article authors themselves). The broad reach and scope of the virtual journal club fosters multi-level and multidisciplinary learning from experts on the most current topics in medicine.⁸

Our VJC model has provided multi-level learners with the opportunity to practice critical analysis skills, presentation design, and public speaking. The pedagogy and learning objectives of our virtual journal club requires student participants to demonstrate

understanding and application of concepts from the medical literature and asks them to constructively analyze and evaluate results and outcomes. These are considered higher level skills in Bloom's Taxonomy and are at the core of efforts to teach self-directed learning and support the transition from medical school to residency and beyond.³²

The format of our virtual journal club encourages collaboration with and across institutions. The students worked together to create presentations centered around a topic or diagnosis of interest by applying it to a real-life case they encountered while on rotation. They used a standardized template and outline format that covered: learning objectives, review of their case, background, article overview, clinical questions, and key points. Completing this process also helped to address medical student core competencies at each home institution and ERAS entries for Presentations and Online Publications.³³ Faculty moderators facilitated the post-presentation discussions, offering teaching opportunities for faculty or potentially interested residents.

Conclusion

The virtual journal club, initiated as a robust solution to many educational challenges encountered during COVID-19 pandemic-related distance learning, provides an enduring and fluid forum for multilevel teaching and learning. The learner-emphasized format meets LCME and ACGME requirements and promotes lifelong learning. Finally, the ease of integrating this educational forum highlights its durable teaching.

Declaration of Competing Interest

The authors confirm there are no known conflicts of interest associated with this publication. There has been no financial support for this work.

Appendix

For a downloadable copy of the VJC template used please visit: <https://msrads.web.unc.edu/journal-club/>

References

- Chetlen AL, Dell CM, Solberg AO, et al. Another time, another space: the evolution of the virtual journal club. *Acad Radiol* 2017 Mar;24:273–85.
- Chan TM, Thoma B, Radecki R, et al. Ten steps for setting up an online journal club. *J Contin Educ Health Prof* 2015;35:148–54. Spring.
- Williams AD, Mann BD. Improved knowledge gain and retention for third-year medical students during surgical journal club using basic science review: a pilot study. *Am J Surg* 2017 Feb;213:238–43.
- Topf JM, Sparks MA, Phelan PJ, et al. The evolution of the journal club: from Osler to Twitter. *Am J Kidney Dis* 2017 Jun;69:827–36.

5. Bolderston A, Watson J, Woznitza N, et al. Twitter journal clubs and continuing professional development: an analysis of a #MedRadJClub tweet chat. *Radiography (Lond)* 2018 Feb;24:3–8.
6. Lehna C, Berger J, Truman A, et al. Virtual journal club connects evidence to practice: an analysis of participant responses. *J Nurs Adm* 2010 Dec;40:522–8.
7. Cadieux M, Campos-Zamora M, Zagury-Orly I, et al. Journal club using virtual breakout rooms: interactive continuing education with no learner preparation during COVID-19. *J Contin Educ Health Prof* 2020;40:217–9. FallErratum in: *J Contin Educ Health Prof*. 2021 Jan 1;41(1):85.
8. Slanetz PJ, Bedi H, Kesler T, et al. Optimizing journal clubs in the post-COVID-19 era. *J Am Coll Radiol* 2020 Nov;17:1496–8.
9. Rodriguez J, Nyante SJ, Henderson L, et al. Radiology resident journal club: enhancements add educational value. *Acad Radiol*. 2020 Apr;27:591–5.
10. Webb E, Naeger DM, Fulton TB, et al. Learning objectives in radiology education: why you need them and how to write them. *Acad Radiol* 2013;20:358–63.
11. Kang SHK. Spaced repetition promotes efficient and effective learning: policy implications for instruction. *Policy Insights Behav Brain Sci* 2016;3:12–9.
12. Kerfoot BP, DeWolf WC, Masser BA, et al. Spaced education improves the retention of clinical knowledge by medical students: a randomized controlled trial. *Med Educ* 2007;41:23–31.
13. Lewis PJ. Brain friendly teaching – reducing learner's cognitive load. *Acad Radiol* 2016;23:877–80.
14. Lehrskov LL, Westen M, Larsen SS, et al. Fluorescence or X-ray cholangiography in elective laparoscopic cholecystectomy: a randomized clinical trial. *Br J Surg* 2020 May;107:655–61.
15. Harringa JB, Bracken RL, Markhardt BK, et al. Magnetic resonance imaging versus computed tomography and ultrasound for the diagnosis of female pelvic pathology. *Emerg Radiol* 2021 Mar 17, <https://doi.org/10.1007/s10140-021-01923-4>. Epub ahead of print. PMID: 33730220.
16. Mullan CP, Siewert B, Kane RA, et al. Can Doppler sonography discern between hemodynamically significant and insignificant portal vein stenosis after adult liver transplantation? *AJR Am J Roentgenol* 2010 Dec;195:1438–43.
17. Accreditation Council for Graduate Medical Education. Common Program Requirements. Available at <https://www.acgme.org/What-We-Do/Accreditation/Common-Program-Requirements>. Accessed April 25, 2020.
18. Liaison Committee on Medical Education. Standards. Available from <https://lcme.org/publications/#Standards>. Accessed May 5, 2021.
19. Accreditation Council for Graduate Medical Education. The Diagnostic Radiology Milestone Project. A Joint Initiative of the Accreditation Council for Graduate Medical Education and The American Board of Radiology. c2012 The Accreditation Council for Graduate Medical Education and The American Board of Radiology. Available at: <https://www.acgme.org/Portals/0/PDFs/Milestones/DiagnosticRadiologyMilestones.pdf>. Accessed April 25, 2020.
20. Accreditation Council for Graduate Medical Education. Diagnostic Radiology Milestones. c2019 The Accreditation Council for Graduate Medical Education. Available from: <https://www.acgme.org/Portals/0/PDFs/Milestones/DiagnosticRadiologyMilestones2.0.pdf?ver=2020-03-10-151835-740>. Accessed April 25, 2020.
21. UNC SOM Core Competencies. Available from <https://www.med.unc.edu/md/curriculum/wp-content/uploads/sites/728/2018/06/UNCSOM-Core-Competencies.pdf>. Accessed April 25, 2020.
22. Itri JN, Yacob S, Mithqal A. Teaching communication skills to radiology residents. *Curr Probl Diagn Radiol* 2017 Sep-Oct;46:377–81, <https://doi.org/10.1067/j.cpradiol.2017.01.005>. Epub 2017 Jan 17. PMID: 28291556.
23. Heilbrun ME. Should radiology residents be taught evidence-based radiology? An experiment with 'The EBR Journal Club. *Acad Radiology* 2009;16:1549–54.
24. Awan O. What makes a great teacher? *RadioGraphics* 2019;39:2167–8.
25. Deenadayalan Y, Grimmer-Somers K, Prior M, et al. How to run an effective journal club: a systematic review. *J Eval Clin Pract* 2008 Oct;14:898–911.
26. Lentscher JA, Batig AL. Appraising medical literature: the effect of a structured journal club curriculum using the Lancet Handbook of Essential Concepts in Clinical Research on Resident Self-Assessment and Knowledge in Milestone-Base Competencies. *Mil Med* 2017 Nov;182:e1803–8.
27. Lee AG, Boldt HC, Golnik KC, et al. Structured journal club as a tool to teach and assess resident competence in practice-based learning and improvement. *Ophthalmol* 2006 Mar;113:497–500.
28. Carpenter CR, Kane BG, Carter M, et al. Incorporating evidence-based medicine into resident education: a CORD survey of faculty and resident expectation. *Acad Emerg Med* 2010 Oct;17(Supple 2):S54–61.
29. Kaur M, Sharma HB, Kaur S, et al. Comparison of two formats of journal club for postgraduate students at two centers in developing critical appraisal skill. *Adv Physiol Educ* 2020 Dec;44:592–601.
30. Lee AG. Using journal club as an approach to teaching and assessing practice-based learning and improvement. *Surv Ophthalmol* 2005 Nov-Dec;50:542–8.
31. Prince KJ, Van De Wiel M, Scherpbier AJ, et al. A qualitative analysis of the transition from theory to practice in undergraduate training in a PBL-medical school. *Adv Health Sci Educ Theory Pract* 2000;5:105–16.
32. Smith EB, Gellatly M, Schwartz CJ, et al. Training Radiology residents bloom-style. *Acad Radiol* 2020, <https://doi.org/10.1016/j.acra.2020.08.013>. Epub ahead of print. Published Sept 10.
33. Association of American Medical Colleges. ERAS Residency Applicant Worksheet: <https://students-residents.aamc.org/eras-tools-and-worksheets-residency-applicants/eras-tools-and-worksheets-residency-applicants> Accessed May 15, 2021.